

Brief Note on Diffusion Models – Bass Model

One model that is often used for the forecasting of diffusions of categories or products is the Bass model. The Bass model tries to capture two forces: On one hand the diffusion of a product is faster because of a segment of consumers who may adopt a product independently of what others do – the innovators. On the other hand, the diffusion of a product is faster because some consumers see others having already adopted the product, and decide to adopt it themselves – the imitators. The Bass model has been successfully used in retail services, industrial technology, agriculture, and the educational, pharmaceutical and consumer-durables markets. The model has been used in companies such as Eastman Kodak, IBM, and AT&T.

The Bass model starts from defining the probability that an adoption will occur at time t given that it has not yet occurred as $f(t)/[1-F(t)] = p + q F(t)$, where $f(t)$ is the density of adoption of the category through time. Note that this probability has a constant term, p , which is a measure of the “innovators” in the market, and a term that is proportional to the percentage of consumers that have already adopted the category at time, $F(t)$, so that q is a measure of the “imitators” in the market.

Multiplying both sides of the probability by the total market potential M , and by $(1-F(t))$, one obtains the sales equation:

$$\text{Sales}(t) = [p + b \text{CumSales}(t)] [M - \text{CumSales}(t)]$$

where the sales at time t , $\text{Sales}(t)$, is just $f(t)M$, and the cumulative sales at time t , $\text{CumSales}(t)$, is just $F(t)M$. The parameter p is known as the “coefficient of innovation”, and the parameter $b=q/M$ is known as the “coefficient of imitation”. This equation represents the sales for a durable product. For a non-durable this equation represents the number of new adopters at time t .

If one knows the parameters p , b , and M one is able to forecast the sales in the category through the category life cycle. The market potential M can be typically obtained directly from secondary data. The coefficients of innovation and imitation, p and b , can be estimated by doing a regression on the “approximation” equation

$$\text{Sales}(t) = [p + b \text{CumSales}(t-1)] [M - \text{CumSales}(t-1)]$$

using the data in the initial periods of the category.

This relationship has been shown to be remarkably robust across industries and to capture the life cycle dynamics of several product categories. Several criticisms have also

been leveled at this model. Among these are (1) not considering the marketing-mix variables, (2) not considering the industry dynamics, and (3) not considering strategic and forward-looking consumers. There have also been several adjustments to the model trying to solve in part some of these criticisms. If you are interested in learning more about this model read the Chapter on “New-Product Diffusion Models” by V. Mahajan, E. Muller, and F.M. Bass, in the Marketing Volume (Volume 5) of the Handbooks in Operations Research and Management Science (North-Holland, 1993).